STRATEGIC COMMAND, CONTROL, AND COMMUNICATIONS: ALTERNATIVE APPROACHES FOR MODERNIZATION

The Congress of the United States

Congressional Budget Office

PREFACE

The United States is currently engaged in a substantial expansion and modernization of the nation's strategic nuclear forces. Those efforts have been accompanied by a reevaluation of military doctrine that would govern use of nuclear weapons in the event of an attack. That evolving new doctrine implies that Soviet aggression can no longer be deterred by a U.S. arsenal that is only capable of prompt and large-scale retaliation, but must also be prepared to sustain nuclear combat of various scales and durations. The Executive Branch has so far focused primarily on the development of the forces' offensive elements, including the MX missile, a new generation of ballistic missile submarines, and a new bomber aircraft. The network that controls and would direct the actions of the offensive forces--the command, control, and communications, or C^3, system--has received relatively little emphasis to date, though many strategists and analysts concur that this critical nervous system is as sorely in need of improvement as the offensive forces themselves. The Senate Armed Services Committee has therefore requested the Congressional Budget Office to study the relative costs and effectiveness of several approaches to upgrading the C^3 system. This paper is an unclassified version of one submitted to that committee this past February.

The study was prepared by John J. Hamre, Richard H. Davison, and Peter T. Tarpgaard of CBO's National Security and International Affairs Division, under the general supervision of Robert F. Hale. Earlier drafts were also reviewed by the former division director, David S.C. Chu. Helpful comments on earlier drafts were given by Edward Swoboda of CBO and Mel Chaskin of Horizons Technology, Inc. (The assistance of external reviewers implies no responsibility for the final product, which rests solely with CBO.) The authors gratefully acknowledge the contributions of Nancy Swope and Ed Shephard, as well as those of Johanna Zacharias, who edited the paper, and Janet Stafford, who prepared the manuscript for publication. In accordance with CBO's mandate to provide objective and nonpartisan analysis, this paper offers no recommendations.

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SUMMARY

Over the past two decades, the United States has fielded an extensive collection of facilities and systems designed to direct and control strategic nuclear forces before and during a nuclear war. This strategic command, control, and communications system, referred to as C^3, consists of ground-based radars and early-warning satellites; land-based and airborne command centers; and elaborate communications networks. The role of C^3 is to alert authorities to a possible attack, permit assessment of the attack's size and targets, and convey the President's orders for retaliation. (Only a President has authority to release nuclear warheads.)

Despite the importance of these C^3 systems, the recent public debate over the adequacy of U.S. nuclear forces has largely overlooked the C^3 system, emphasizing instead the need to update the bombers, submarines, and land-based missiles that would deliver strategic weapons. Far less attention has been given to the C^3 system, though it has been termed the weakest link in the nation's present strategic forces. The need to make major investments in C^3 modernization is considered in some quarters to be an urgent one. Investment in C^3 systems in recent years has largely sought to correct deficiencies in current operations and improve performance of existing assets. To that end, the Defense Department is providing "survivable" ground stations for early-warning satellites, and improving selected command-post aircraft.

THE NEW STRATEGIC DOCTRINE'S REQUIREMENTS FOR C^3

The basic structure of the present strategic C^3 system was designed and established in the 1960s to meet requirements of the strategic doctrine that prevailed at that time. The now superseded strategic doctrine, centered around the concept of "mutually assured destruction," stressed the ability to fight a war that consisted of a series of massive but brief nuclear exchanges. Thus, the primary functions of the C^3 system were to detect and confirm an attack and to relay the President's retaliation directives to the nuclear forces.

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The recently redefined U.S. strategic doctrine--envisioning varied and potentially prolonged exchanges of nuclear weapons--and the planning for it have enormous implications for the C^3 system. Though deterrence remains the cornerstone of U.S. strategic thinking, analysts now argue that the threat of prompt, large-scale retaliation may no longer be sufficient to avert a Soviet attack. Most analysts now presume that a Soviet attack might initially be directed not against U.S. cities and industries but against U.S. military facilities. A U.S. President facing such an attack and fearing a second Soviet strike against U.S. urban and economic centers might not order initial retaliatory strikes against Soviet cities and industry.

In keeping with such assumptions, deterrence must derive, it is argued, from the United States' ability to deal with a wide range of potential threats, with responses tailored to the provocation. Recent strategic guidance, embodied in Presidential Directive 59 (PD-59), emphasizes this need to support a broader range of responses short of--and including--massive retaliation. Such guidance demands that not only must the C^3 system give warning of an attack, but it must also generally characterize the nature of that attack. The call for such improved responsiveness also implies that the C^3 system might need more flexible control over the forces themselves during the course of the attack (that is, the "trans-attack" period). The guidance also suggests that nuclear exchanges might not be quick exchanges, but that they might last weeks or even months (a "post-attack" period). In short, the system must not only survive; it must also continue to function for as long as it is needed. Secretary of Defense Caspar Weinberger recently reported that these policies, as well as investment strategies to support them, are being reviewed, and major decisions are expected this fall.

The new strategic doctrine, then, suggests two different, and to some degree conflicting, courses for C^3 modernization: greater responsiveness in the initial stages of an attack, and a need for endurance. Technologically sophisticated systems designed to enhance responsiveness are unlikely to survive to function for long periods after a nuclear attack. Similarly, extended operations in any post-attack period cannot rely on systems requiring relatively elaborate support and maintenance. Thus, in choosing improvement investments for the future, the Congress must decide whether to focus C^3 modernization on responsiveness or on endurance, or whether to stress both objectives by pursuing both courses simultaneously.

THREE ALTERNATIVES FOR C^3 MODERNIZATION

Compared to the expenditures projected for the offensive strategic forces over the coming five years, the costs of modernizing the C^3 system are modest. Spending for the nuclear forces could exceed $130 billion (in constant fiscal year 1982 dollars) by the end of fiscal year 1986; the three alternative approaches to C^3 modernization described below would range in cost from $8.9 billion to $9.8 billion. (The components of the three options are enumerated in Summary Table 1; the projected costs are presented in Summary Table 2.)

Option I. Improve System Responsiveness in the Trans-Attack Period

To enhance the responsiveness of the C^3 system during the trans-attack period, improvements in two areas presumably would be required. One set of initiatives would seek to provide more timely and accurate information about an attack by means of added investment in radar warning systems. This would better permit the President to tailor retaliation directives appropriate to the level of provocation, and to do so in the very limited time available. (The time between launch and arrival on target of a Soviet ballistic missile could be as short as 15 minutes, and possibly even less for U.S. coastal targets.) A second initiative would expand direct control over force execution in the trans-attack period. Rather than executing pre-planned attack orders, nuclear force commanders would be able to adapt plans of action and redirect forces as circumstances changed during the course of a nuclear exchange. More sophisticated command-post aircraft and improved two-way communications links would be needed to support such battle management objectives.

These initiatives would bring the total cost of the C^3 system over the next 10 years to $16.3 billion. This represents an increase of $2.4 billion above costs of the current system.

Though the improved responsiveness sought by Option I appears desirable, it is less clear that the improvements it would make would solve some of the more critical problems associated with strategic command and control. Additional investment in warning systems would provide more information to the President (or a designated successor), but not more time for making a decision. Similarly, if the President did not survive to issue retaliation orders, the ability to alter pre-planned attack options would be

SUMMARY TABLE 1. COMPONENT MODIFICATIONS OF STRATEGIC C^3 IMPROVEMENTS FOR THE FUTURE

System Function	Option I. Improve System Responsiveness
Sensor/Warning System	Deploy MGTs for satellite early-warning system
	Deploy Integrated Operational Nuclear Detonation Detection System (IONDS)
	Modify PAVE PAWS radars
	Deploy two additional PAVE PAWS installations
Command Centers	Complete E-4A conversion to "B" configuration
	Procure two additional E-4Bs
	Continue EC-135 modernization, including EMP (electromagnetic pulse) hardening
Communications Systems	Develop STRATSAT as successor AFSATCOM system
	Procure Very Low Frequency (VLF) receivers for bombers
	Develop advanced High Frequency (HF) radio system

SOURCE: Congressional Budget Office.

SUMMARY TABLE 1. (Continued)

Option II. Improve System Endurance	Option III. Improve System Responsiveness and Endurance
Deploy MGTs for satellite early-warning system	Deploy MGTs for satellite early-warning system
Deploy IONDS	Deploy IONDS
	Modify PAVE PAWS radars
	Deploy two additional PAVE PAWS installations
Complete E-4A conversion to "B" configuration	Complete E-4A conversion to "B" configuration
Terminate further E-4 procurement	Procure two additional E-4Bs
Continue EC-135 modernization, including EMP hardening	Continue EC-135 modernization, including EMP hardening
Develop and deploy ground-mobile command posts	Develop and deploy ground-mobile command posts
	Develop STRATSAT as successor AFSATCOM system
Procure VLF receivers for bombers	Procure VLF receivers for bombers
Develop advanced HF radio system	Develop advanced HF radio system
Develop mobile VLF radio system	Develop mobile VLF radio system
Develop survivable launch satellite system	Develop survivable launch satellite system

NOTE: Explanation of terms can be found in Appendix Glossary.

SUMMARY TABLE 2. PROJECTED COSTS OF C^3 MODERNIZATION ALTERNATIVES, FISCAL YEARS 1982-1991 (In millions of fiscal year 1982 dollars)

Options, by System Function	1982	1983	1984	1985	1986	1987 to 1991	Ten-Year Total
Continuation of Current Policy a/							
Warning	790	680	680	530	670	3,220	6,570
Command	500	260	360	260	260	1,280	2,920
Communications	390	420	470	410	530	2,190	4,410
Total	1,680	1,360	1,510	1,200	1,460	6,690	13,900
Option I							
Warning	980	850	680	540	680	3,270	7,000
Command	500	560	660	260	260	1,650	3,890
Communications	400	540	650	610	760	2,460	5,420
Total	1,880	1,950	1,990	1,410	1,700	7,380	16,310
Option II							
Warning	790	680	680	530	670	3,220	6,570
Command	530	330	420	320	330	1,570	3,500
Communications	410	570	700	610	800	2,560	5,650
Total	1,730	1,580	1,800	1,460	1,800	7,350	15,720
Option III							
Warning	980	850	680	540	680	3,270	7,000
Command	530	630	720	320	330	1,940	4,470
Communications	420	600	790	730	960	2,850	6,350
Total	1,930	2,080	2,190	1,590	1,970	8,060	17,820

SOURCE: Congressional Budget Office estimates.

NOTE: All estimates include both investment and operating costs. IONDS costs are excluded for reasons of national security.

a/ Includes costs of modernization programs already authorized.

of little value until a designated Presidential successor had been identified and located, which might take some time.

Option II: Improve System Endurance in the Post-Attack Period

In response to these concerns, the Congress could choose to emphasize a C^3 system that survives the initial stages of an attack. Endurance of the current system is weakened by the small number of critical, vulnerable facilities--especially the land-based command centers. During the early 1960s, in view of the vulnerability of these fixed ground facilities, the Department of Defense fielded specially fitted aircraft to serve as "survivable" command centers. But to sustain operations, command-post aircraft still require suitable runways and quite elaborate support equipment, which could not be expected to be available in the aftermath of nuclear exchanges.

Option II contains programs specifically designed to provide enduring command and control by emphasizing ground mobility. The option provides for deployment of ground-mobile command posts and communications systems that would be installed in trucks. At any given time, a number of the vans would be moving randomly and covertly to avoid being targeted by Soviet missiles; additional vans would be fielded in times of crisis. These ground-mobile command posts and communications systems would augment operations of command-post aircraft in the initial stages of a conflict, and they would gradually take over full operations as the aircraft were forced to land.

Since the programs contained in Option II are designed to improve the system's ability to ride out an attack, the option puts less emphasis on improved warning and surveillance capabilities than does Option I.

Option II would cost \$15.7 billion over the next 10 years, some \$1.8 billion, or 13 percent, more than will be necessary to continue operation of the current system.

Option III: Improve Both System Responsiveness and Endurance

Improvements in both responsiveness and endurance are clearly desirable, but they cannot be accomplished by the same set of investments. Improved force management during a nuclear conflict requires extremely sophisticated and expensive command facilities and systems. At the same time, cost considerations stem from peacetime economic concerns, which limit backup redundancy and narrow the number of critical facilities to relatively few. Thus, efforts to refine system operations in the opening moments of an attack would further contribute to the limited endurance of the existing command and control system. Alternatively, the key to survival and endurance depends largely on ground mobility, probably in conjunction with covert peacetime operations. This by definition limits the range of activities such a system can support.

Though the programs that would meet the responsiveness objectives of Option I would not achieve the endurance goals of Option II, the Congress could choose to improve both aspects of the C^3 system. Indeed, to achieve both goals, pursuing both options simultaneously would be necessary.

Even though Option III would require a substantial increase in funding for C^3, the amount would represent only a small portion of the total strategic forces budget. The Congressional Budget Office estimates that implementing the programs contained in Option III would cost $17.8 billion over the next 10 years, an increase of $3.9 billion above costs of the current system. Of that amount, $9.7 billion would be expended in the first five years. Yet overall strategic forces expenditures during those five years are expected to exceed $130 billion.

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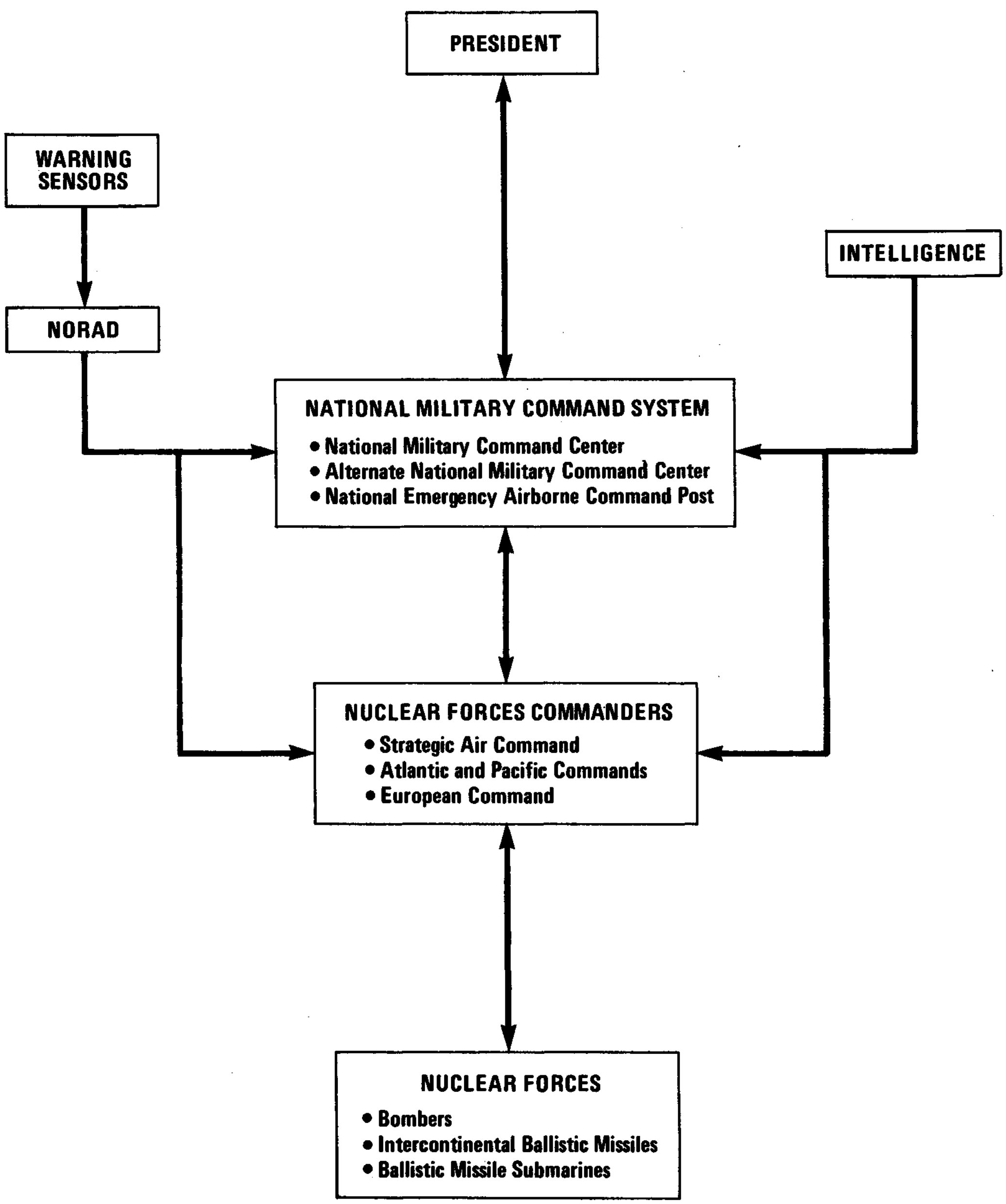
Figure 1.
U.S. Strategic Command, Control, and Communications System



CHAPTER I. INTRODUCTION

The United States' strategic offensive nuclear forces comprise three elements--the so-called triad consisting of land-based and sea-based ballistic missiles and long-range bomber aircraft. A fourth element, as important as the forces themselves, is the collection of special facilities and systems that allows civilian and military commanders to communicate with and direct those forces. This strategic command, control, and communications system, called C^3 (said "C-cubed"), consists of early-warning satellites and ground-based radars, command centers (both land-based and airborne), and elaborate communications systems. (The various acronyms and abbreviations of terms used in this paper are defined in the Appendix glossary.) Functioning together, these components would alert U.S. authorities to a possible attack, provide information for assessing the assault's size and targets, and direct U.S. forces to respond as ordered by the President (the sole party authorized to order launch of U.S. nuclear forces). The structure and organization of the C^3 system are diagrammed opposite.

Recent public debate over the adequacy of U.S. strategic forces has focused primarily on the need to update the offensive triad. Until now, relatively little attention has been given to the command and control components of the systems, though a major initiative announced by the Department of Defense (DoD) in early August 1981 suggests that C^3 may well undergo significant modernization in the near future. 1/ So pressing have some critics considered the need to improve strategic command and control that one DoD spokesman labeled the system "perhaps the weakest link in our strategic forces today." 2/ Yet funding for

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1/ At the time of publication of this study, the details of DoD plans, reportedly under review by Secretary of Defense Caspar Weinberger, are not available and, indeed, may not be fully formulated.

2/ See testimony of Hon. William J. Perry, Under Secretary of Defense for Research and Engineering, in Military Posture and H.R. 1872, Department of Defense Authorization for Approstrategic C^3 at present represents only a small fraction of the total U.S. budget for strategic nuclear forces. The Congressional Budget Office estimates that expenditures on nuclear forces over the next five years could exceed $130 billion; spending on the C^3 systems that support those forces, however, will range between $7.2 billion and $9.8 billion.

SYSTEM DEFICIENCIES AND RECENT PROGRAM INITIATIVES

The primary emphasis of recent and ongoing efforts has been to correct deficiencies in the existing C^3 system. The current system has been considered flawed in three main areas:

- Several critical functions, notably tactical warning, have depended on facilities that were too few and too vulnerable to nuclear attack;

- Communication links to the nuclear forces were tenuous and for the most part, capable only of reliable one-way communications;

- Numerous important facilities and systems were vulnerable to secondary effects of nuclear detonations, particularly to electromagnetic pulse, which could disrupt reliable operations at the most critical times.

The Defense Department has launched several programs designed to correct these deficiencies. Though a number of programs are still being implemented, major advances in C^3 system operations have already been made. The system now appears to have the capacity to support the most fundamental requirement of nuclear forces--prompt and massive response to a Soviet attack. That type of response, however, may not prove adequate to meet the demands of deterrence as they are being defined in the context of a new defense doctrine evolving under the Carter and Reagan Administrations.

NEW REQUIREMENTS FOR STRATEGIC C^3

The substantial buildup of Soviet nuclear forces during the 1970s and closer attention on the part of U.S. defense planners to

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priations for Fiscal Year 1980, Hearings before the House Committee on Armed Services, 96:1 (February, March, and April 1979), Part 3, Book 1, p. 233.

Soviet strategic doctrine and policy have led to a redefinition of U.S. strategic doctrine. Deterrence continues to be the cornerstone of that doctrine, but the means toward this end are changing. In the 1960s, the capacity for prompt, large-scale retaliation was considered sufficient to deter Soviet aggression. Current strategic doctrine is more varied, however, emphasizing a need to be able to "respond to the broadest plausible range of scenarios . . . at a level appropriate to the type and scale of Soviet attack." 3/ Reportedly, this new emphasis has become official guidance enunciated in Presidential Directive 59. 4/

Underlying this evolution in doctrine is a change in the consensus regarding the possible circumstances leading to a nuclear war and the ways in which it might be conducted. The now superseded doctrine of "mutual assured destruction" (MAD) presumed unambiguous situations and responses: each side would respond to a nuclear attack by destroying the aggressor's cities and industries. 5/

Today there is far less consensus among defense analysts on the possible circumstances that might lead to nuclear war and the way in which it might be pursued; there is less agreement, therefore, on how it might be deterred. A massive exchange might or might not be preceded by a series of limited nuclear strikes. Both an initial attack and a counterstrike might or might not be directed against civilian and military command systems. An assault might involve thousands of nuclear warheads against missile silos and other military installations or dozens targeted against special groups of facilities or installations. Finally,

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3/ U.S. Department of Defense, Annual Report, Fiscal Year 1981, p. 66.

4/ See "Remarks Prepared for Delivery by the Honorable Harold Brown, Secretary of Defense, at the Convocation Ceremonies for the 97th Naval War College Class" (Department of Defense News Release, August 20, 1980).

5/ In fact, mutual assured destruction was never so simplistic as popular public understanding held. As Secretary of Defense under the Carter Administration, Harold Brown noted, for example, that MAD always presumed the opponent's military facilities would be subject to attack, not just its cities and industry.

whereas the prevailing assumption used to be that a series of exchanges would last but a few hours, analysts today believe such an exchange could stretch over a matter of days or even weeks.

ALTERNATIVE STRATEGIES FOR C^3 MODERNIZATION

These new assumptions suggest two primary areas for additional investment. First, steps might be taken to enhance the responsiveness of the C^3 system, enabling it to support a broader range of retaliatory options during the first few hours of a conflict. Second, with the prospect of a nuclear conflict's stretching over weeks or even months, measures might be taken to improve system endurance.

Although improvements in both responsiveness and endurance are clearly desirable, they are not compatible objectives from the standpoint of modernization. Improved management of forces during the course of a nuclear conflict requires extremely expensive, technologically sophisticated command facilities and systems. Greater sophistication, in turn, would tend to introduce more areas of potential vulnerability, thus limiting system endurance. At the same time, cost considerations emphasize peacetime economy, thereby limiting the number of facilities to a small number with large burdens of responsibility. Both factors contribute to the limited endurance of the existing command and control system. Thus, in planning future investments to improve C^3, the Congress must either make a choice between responsiveness and endurance, or at greater cost, it can pursue a course that would enhance the system in both respects simultaneously.

FRAMEWORK OF THE PAPER

This study examines the current system and discusses alternative improvement strategies available for Congressional review. Chapter II examines the current system and areas in which it might prove unable to support new strategic policies. Chapter III outlines three alternative modernization strategies and analyzes the costs associated with each.

CHAPTER II. STRUCTURE AND LIMITATIONS OF THE STRATEGIC C^3 SYSTEM

Prompt, large-scale retaliation--the so-called "mutual assured destruction" that dominated strategic thinking in the 1960s--is presumably still contemplated by the Defense Department. More attention, however, is now being given to a multitude of lesser nuclear threats and responses, with enormous potential implications for the command, control, and communications system. Under the old strategic doctrine, the so-called "trans-attack" period--that is, the span during which the actual exchange occurred--was envisioned to last only minutes or hours, and the likeliest targets were thought to be urban and economic centers. What little attention was given to the aftermath of such an exchange, the so-called "post-attack period," was generally limited to civilian recovery and continuity of government. The C^3 system was responsible for providing reliable and timely warning information; the system was thought to need to survive only long enough to relay a President's order to retaliate. The new doctrine, in contrast, envisions a continuation rather than a cessation of nuclear exchanges during the post-attack period. The capacity of the C^3 system to remain functional, therefore, has become critical.

CURRENT STRATEGIC C^3 SYSTEM

U.S. strategists plan on the assumption that a nuclear strike could come as a virtual surprise or--as is now considered more likely--after some warning, such as after a period of non-nuclear conflict, when strategic forces have been placed in a condition of "generated alert." 1/ Regardless of warning time, however, the basic functions accomplished by the C^3 system are

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1/ In the context of a nuclear war, "tactical warning" is defined as an indication that missiles have actually been launched or that bombers are en route to their targets. Strategic warning would consist not of indications of the actual attack itself, but of evidence of mobilization efforts or precautionary survival actions on the part of Soviet forces.

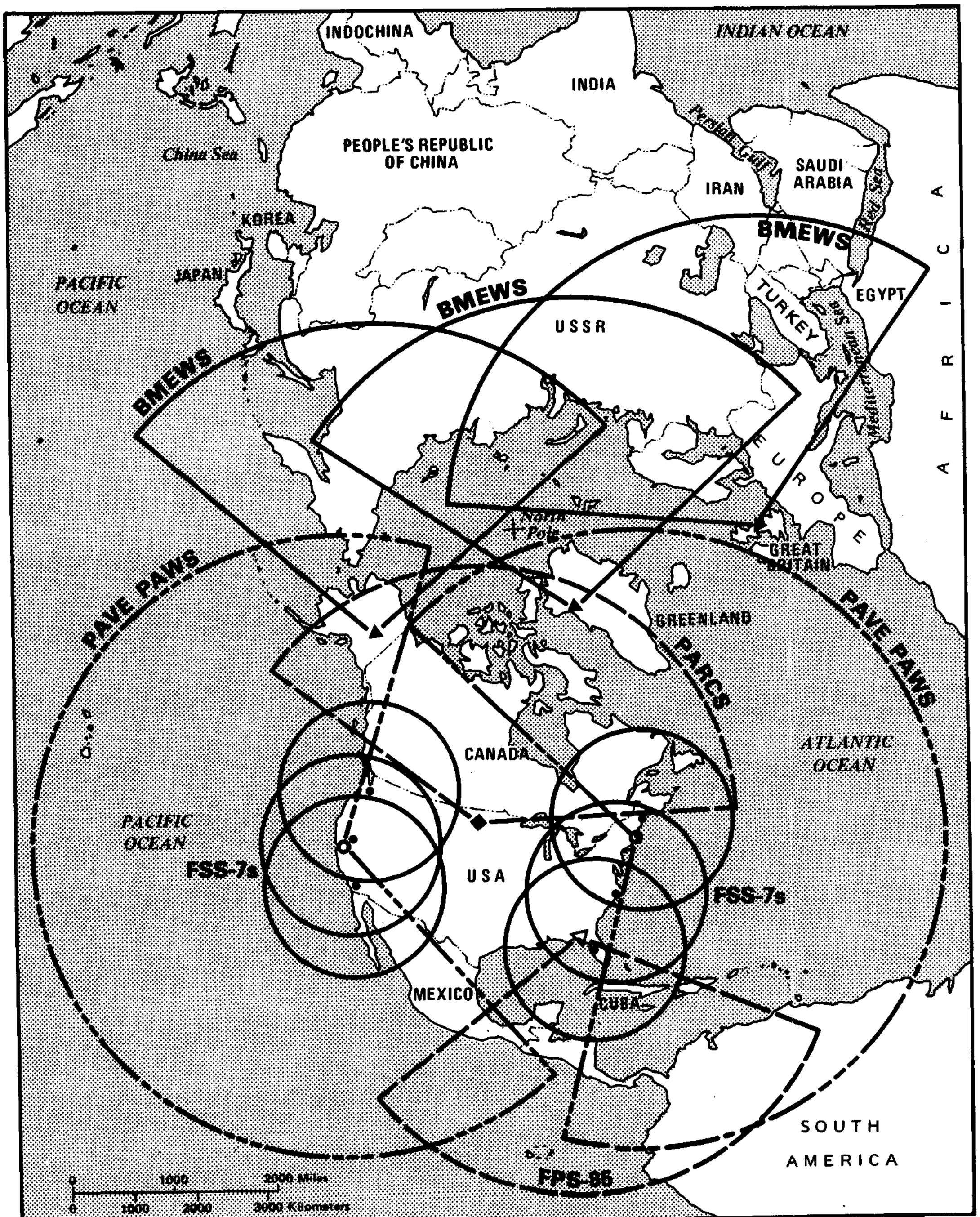
relatively simple, despite the myriad factors that can complicate the procedure. This chapter reviews how the C^3 system is expected to function; it also assesses the system's current capabilities and describes how those capabilities could be degraded by enemy actions.

Tactical Warning

The earliest antecedent of C^3, the first tactical warning system designed to alert authorities of nuclear attack was the Distant Early Warning (DEW) Line, fielded in the 1950s to detect approaching Soviet bombers. Advances in Soviet technology in the 1950s, including development of missiles with intercontinental ranges demonstrated by the launch of the Sputnik satellite, led to deployment of a number of U.S. tactical monitoring systems. An array of ground-based and satellite warning sensors is now in place as the United States' first system for detecting the approach of missiles. Initial reports of an attack would come from the early-warning satellites. These satellites have sensitive infrared radiation sensors to monitor the launch of land-based Soviet intercontinental ballistic missiles (ICBMs) or submarine-launched ballistic missiles (SLBMs). 2/ Next, the incoming missiles would be detected by large ground-based radars, including those of the Ballistic Missile Early Warning System (BMEWS) for ICBMs, and the newly operational PAVE PAWS radars for SLBMs. With the important exception of the satellite early-warning system, all detectors are ground-based radars. Figure 2 shows the location and approximate area of coverage of the various C^3 warning systems; Table 1 lists the sites of the bases.

2/ The satellite early-warning system, which became operational in the early 1970s, consists of three satellites, each in a fixed position relative to the earth. At an altitude of approximately 21,000 nautical miles, a satellite would complete one orbit per day. If launched over the equator, a satellite at this "geosynchronous" orbit would move at precisely the same speed as the earth's rotation. Thus, it would remain fixed relative to the earth, permitting it to monitor most of an entire hemisphere at any given time.

Figure 2.
Land Based Ballistic Missile Warning Sites and Detection Sweeps



SOURCE: Compiled by the Congressional Budget Office from unclassified sources.

NOTE: See Appendix Glossary for explanation of terms.

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TABLE 1. PRESENT U.S. LAND-BASED BALLISTIC MISSILE WARNING SITES AND DETECTION RANGES

Radar Installation	Location(s)	Range (Statute miles)
Ballistic Missile Early Warning System (BMEWS)	Thule, Greenland Clear, Alaska Fylingdales Moor, England	3,000
FSS-7 SLBM Detection and Warning System	Mt. Hebo, Washington Mill Valley, California Mt. Laguna, California MacDill Air Force Base, Florida Ft. Fisher, North Carolina Charlestown, Maine	850
PAVE PAWS SLBM Detection and Warning System a/	Otis Air Force Base, Massachusetts Beale Air Force Base, California	3,000
FPS-85 SLBM Detection Radar b/	Eglin Air Force Base, Florida	2,500
Perimeter Acquisition Radar Characterization System (PARCS) c/	Concrete, North Dakota	2,500

SOURCE: Congressional Budget Office compilation from unclassified sources.

a/ The PAVE PAWS radars replace operations of five of the six FSS-7 installations, though they could be returned to operational status quickly. The FSS-7 at MacDill Air Force Base will be retained in operation.

b/ Originally the FPS-85 radar was used to track space launches from Cape Canaveral and other space-tracking functions. It has since been converted to use primarily as an early-warning radar.

c/ The PARCS radar is the only portion of the Safeguard ABM site in North Dakota still in service. It is now used primarily for early-warning and space-tracking functions.

Since the consequences of faulty or incomplete warning information are potentially drastic, DoD requires that data from two different subsystems of the tactical warning system be used for detection and confirmation. 3/ Thus, ground-based radars, which originally were deployed to furnish initial warning of an attack, now would be used primarily to confirm the validity of attack information coming from early-warning satellites. The satellites are far more important, since they monitor the launch areas directly, whereas ground radars can monitor only approach corridors. Thus, the satellites can provide the greatest amount of warning time.

Command Centers

Detection of an attack by any of the tactical warning systems would trigger pre-planned activity in the various command centers situated around the country. The primary responsibility for evaluating attack reports rests with the Commander of North American Air Defense Command (CINCNORAD), with headquarters in the Cheyenne Mountain complex in Colorado. NORAD Headquarters would initiate a conference with the Strategic Air Command (SAC) Headquarters in Omaha, Nebraska, and with the National Military Command Center (NMCC) in the Pentagon outside of Washington, D.C. to determine the validity of warning information and the severity of the reported attack. 4/ If confident that the nation was under nuclear attack, the President and the Secretary of Defense, together known as the National Command Authorities

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3/ The policy of deploying two independent means to detect and verify an attack is termed "dual phenomenology."

4/ The National Military Command Center (NMCC) in the Pentagon is actually one of three national-level command posts. National-level command centers are of particular significance, since they provide the critical link between the President, who alone is authorized to order the use of nuclear weapons, and the nuclear forces. The other national-level command centers include the Alternate National Military Command Center (ANMCC), buried in a mountain at Ft. Ritchie, Maryland, about six miles from Camp David; and the National Emergency Airborne Command Post (NEACP), a specially fitted Boeing 747 aircraft stationed at Andrews Air Force Base near Washington, D.C.

(NCA), would be alerted and briefed on the situation, and they would decide upon a course of action. 5/

Communications Systems

The communications portions of the C^3 system serve three functions of critical importance. First, they must establish immediate contact with nuclear force commanders and other military advisors responsible for evaluating a reported attack and recommending response options to the President. Second, they provide the link between the nuclear force commanders and the President or his successor. Third, they alone bear the President's specially encoded emergency action message (EAM), which contains his orders for retaliation. Proper coding and formatting of EAMs is of crucial importance, since nuclear forces are prepared to execute any messages they receive that meet the rigid specifications. In addition to the specific instructions contained in an EAM, proper coding provides the means by which a commander expresses his authority to release nuclear weapons and an officer controlling those weapons verifies that authority. Two unique considerations dictate a need for elaborate, specialized communications systems. First, only the President is authorized to direct the release of nuclear weapons; and second, decisions to respond to a nuclear attack would probably have to be made extremely quickly, since incoming ICBMs could be expected to reach their targets in as little as 30 minutes after launch and SLBMs in less than half that time.

5/ The President alone has authority to direct the release of nuclear weapons. A lawful successor to the President would gain such authority only after assuming the Presidency according to established procedures. The identification, location, and support of presidential successors in the event of war is, of course, a significant problem in itself. The possibility of early destruction of Washington, D.C. and the major fixed command posts naturally raises the issue of the availability of the National Command Authorities for making a response decision. Although clearly an important problem, this is somewhat separate from the issues addressed in this paper and, in any event, is not likely to be resolved by Congressional action on the budgetary issues discussed here. The security of the NCA and its availability is not, therefore, discussed further in this paper.

THE C^3 SYSTEM'S VULNERABILITIES

Though nuclear forces have developed substantially in the last decade, the C^3 system has undergone little change. The system has been deemed vulnerable to attack and disruption. Strategists feel that there are, in fact, many actions that an enemy could take--and indeed could be expected to take--to disrupt the strategic C^3 system.

Susceptibility to Attack and Sabotage

Direct attack against key nodes, or centers, of the C^3 network is one obvious and straightforward way of disrupting U.S. retaliatory capacity. A small number of installations make up the C^3 network. For example, there are only 13 early-warning radar sites to detect missiles; three national-level command centers; 15 command-post installations for nuclear force commanders-in-chief; and eight large, ground-based, very low frequency (VLF) radio transmitters to submarines and ICBM launch-control centers. 6/ These and other key facilities present Soviet planners with a relatively small number of targets, especially compared to the thousands of nuclear weapons the Soviet Union deploys.

Since relatively few fixed installations are involved, sabotage must also be considered a significant threat in a sudden nuclear attack. A coordinated series of sabotage incidents could be particularly disruptive in such a time-sensitive scenario as nuclear attack. Obviously, poorly executed sabotage efforts could serve to increase warning time. Nonetheless, if acts of sabotage confounded clear evaluation for only a few tens of minutes, command-post aircraft, bombers, and tanker aircraft might be destroyed on the ground.

To compensate for the vulnerability of fixed ground-based facilities, certain critical command and control elements are

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6/ See U.S. Department of Defense, Annual Report, Fiscal Year 1980, p. 126; U.S. General Accounting Office, An Unclassified Version of a Classified Report Entitled "The Navy's Strategic Communications Systems - Need for Management Attention and Decisionmaking" (May 1, 1979), p. 33; U.S. Department of Defense, Annual Report, Fiscal Year 1981, p. 140.

kept airborne to prevent destruction in a surprise attack. For the past 20 years, SAC has kept a fleet of command-post aircraft, known collectively as "Looking Glass," to maintain a continuous airborne watch over the central United States. The Looking Glass mission is flown by EC-135 aircraft (modified Boeing 707s) manned by small battle staffs commanded by general officers who would carry out the President's retaliatory directives. 7/ Similarly, to reach patrolling submarines carrying missiles, the Navy keeps radio relay aircraft, called TACAMO (modified C-130 transports), continuously airborne over the Atlantic. 8/ In periods of heightened international tension, more aircraft and crews are put on either ground or airborne alert to improve their survival prospects. With respect to tactical warning, there are currently no "survivable" counterparts to fixed installations, though a program to field mobile terminals for the satellite early-warning system has been initiated. 9/

Physical "survivability" has also become a potential problem for military satellites. The Soviet Union first began testing a system to assault satellites in the late 1960s and, after a brief hiatus, resumed tests a few years ago. An antisatellite threat must be viewed seriously, if only because of the increasing U.S. reliance on military satellites for early warning and communications. As noted above, the early-warning satellite system is the most important tactical warning system. Though there is disagreement among technologists about the significance and extent of Soviet antisatellite efforts and capabilities, physical attack cannot be considered a threat only to fixed ground-based facilities.

7/ U.S. Department of Defense, Annual Report, Fiscal Year 1981, p. 140. Each of the other nuclear force commanders-in-chief except for NORAD has command-post aircraft. For cost reasons, however, they are not flown on continuous airborne alert.

8/ TACAMO stands for Take Charge and Move Out.

9/ Data from the early-warning satellites are now processed at fixed ground locations. DoD has proposed fielding a number of vans containing appropriate processing equipment to continue minimum operations should the ground stations be destroyed.

Limited Response Time

Though not a system vulnerability per se, the limited response time associated with nuclear strikes is perhaps the most stressful factor affecting strategic C^3 systems. As noted above, Soviet ICBMs could hit their targets within 30 minutes of launch, and SLBMs could land in 15 minutes or possibly even less for coastal targets such as Washington, D.C. And Soviet planners could tailor an attack to minimize warning time. Some of that half hour or less would be needed to detect and confirm the attack. Still more time would be required to alert forces (launch bombers, for example) and relay orders. Thus, not all of even 15 or 30 minutes would be available for the President to decide what to do if faced with an attack, especially if it came as a total surprise.

Recent experience with false alerts at NORAD accents the critical issue of limited response time. Even if all warning systems functioned properly, time for evaluation and decisionmaking would still be confined to minutes. If warning data were ambiguous or suspected to be spurious, response time would become even more critical.

This limited response time places greatest urgency on force survival actions to ensure that strategic forces could escape destruction. Alert bombers, tanker planes, and command and communications aircraft must be directed to take off. In the past, only bombers have relied on tactical warning for survival. Until recently, ICBMs in "hardened" blast-resistant shelters were thought safe from attack, but their ability to survive has now come into question. Launch-under-attack has been suggested as a solution to Minuteman vulnerability. Unambiguous tactical warning would then become just as critical for ICBMs as it now is for bombers. Ballistic missile submarines at sea, however, are likely to remain safe for the next decade or so.

Disruptive Effects of Nuclear Detonations

Electronic systems, which constitute the backbone of strategic C^3, could be substantially impaired even without a direct attack. Nuclear detonations produce numerous side effects that could disrupt electronic systems; the most notable of these is electromagnetic pulse (EMP). A nuclear blast over U.S. territory would generate an electromagnetic pulse that could cause widespread damage or disruption to the sophisticated